PROPOSAL

FOR

HIGHWAY IMPROVEMENT

in the County of Cook, Illinois

WALLY S. KOS, P.E.
SUPERINTENDENT OF HIGHWAYS

Section 04-B8431-08-PV on Route No. B84

Known as 171st Street Reconstruction

Wood Street to Ashland Avenue

VOLUME 2

STORM WATER PUMP STATION

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Storm Water Pump Station

GENERAL

Furnish and install a Quadraplex Storm Water Pump Station including pumps, controls, and building.

The system shall include submersible pumps with MTM sealing flanges, discharge base elbows, guide rails, discharge piping, upper & lower guide rail supports, access hatches, wiring bracket as required, all installed into a precast concrete basin. The system shall also include a precast concrete valve vault, which shall house the discharge piping, plug valves, check valves, and sump pump. Structure and dimensions to be as shown on the drawings.

The electrical/control equipment shall include a motor control center and instrumentation as follows and as shown on the plans.

The electrical/control equipment is to be installed into a prefabricated concrete control building with electric heater, exhaust fan and louvers, receptacles, switches, interior and exterior lighting and smoke detector as shown in the plans.

EQUIPMENT RESPONSIBILITY

All pump station components including the pumps and motors, controls, and building shall be furnished by a single equipment supplier. The equipment supplier shall have responsibility for the complete and proper operation of the new equipment as specified and furnished. The system supplier shall furnish 24-hour service for the complete system, and shall stock all parts used of the installation. Start-up services shall be included, and shall include operating instruction to the operators. The equipment shall be as manufactured and furnished by Metropolitan Pump Company, Romeoville, IL, 815-886-9200, or approved equal.

WET-WELL AND VALVE VAULT

General

A concrete wet well basin and external valve vault shall be supplied by the contractor. The wet well shall have a minimum inside dimension as shown on the plans. The access frame and hinged covers shall be cast into the basin top. Pump mounting base elbows shall be bolted to basin bottom with ¾" anchor bolts. Discharge piping from pump bases shall be mounted in the basin and extended through the basin wall.

Piping:

Piping in the basin shall be ductile iron pipe and shall connect to valves in an external valve vault. The valve vault shall include four (4) full body check valves and five (5) two-way plug valves, manufactured by Dezurik, or approved equal. One of the plug valves shall be for use with a bypass riser and quick disconnect hose coupling for portable pump connection. The pump guide rails shall be 3" schedule 40 type 304 stainless steel pipe for the High Service Pumps and 2" schedule 40 type 304 stainless steel pipe for the Jockey Pumps. Intermediate guide rail supports shall be used. A 6" x 20" space saver flange shall be used for jockey pump discharge pipe connection to the cross as shown on the plans.

Metal-To-Metal Rail System:

The MTM rail system shall include a discharge base elbow, stainless steel base elbow spacer, sealing flange with rail guide, upper guide bracket, stainless steel lifting chain, and stainless steel guide rails. The stainless steel base elbow spacer shall be supplied by the pump supplier.

The discharge base elbow shall have mounted directly on the sump floor and sized according to the plans. It shall have a standard 125 lb flange, with machined face. The design shall be such that the pump to discharge connection is made without the need for any nuts, bolts, or gaskets. The base elbow shall support the stainless steel guide rails.

The sealing flange/rail guide bracket shall be mounted on each pump discharge. It shall have a machined mating flange, which matches the base elbow discharge connection. Sealing of this discharge connection shall be accomplished by simple linear downward motion of the pump culminating with the entire weight of the pumping unit supported entirely by the base elbow.

The upper guide bracket shall align and support the two guide rails at the top of the sump. It shall bolt directly to the hatch frame and incorporate an expandable rubber grommet.

Each pump shall be provided with a stainless steel lifting chain, and be of sufficient length to extend from the pump to the top of the wet well. The access frame shall provide a hook to attach the chain when not in use. The lifting chain shall be sized according to the pump weight.

Access Frames and Covers

A quadraplex access frame assembly shall be supplied for the High Service Pumps and Jockey pumps, as shown on the plans. The size of the access hatches shall be coordinated with the pump supplier to ensure proper pump removal. A separate triplex access cover and simplex access cover shall be provided in the valve vault for access to the vault and bypass pump connection. Access frame and covers shall be fabricated of 316L stainless steel and bolted to basin. The frame shall support the guide rails and the electrical wiring bracket. A separate hinged cover shall be provided for each pump. Cover shall be provided with lifting handle and safety latch to hold cover in the open position. Locking hasps shall be furnished for each cover.

Fall-Through Prevention System

All access openings shall be fitted with a permanently installed fall through prevention rail and net system that is easily retractable for access to the opening below. The system shall be Hatch Net 121 as manufactured by Safe Approach, Inc., or approved equal. The system shall consist of the following components:

* A polyester safety net manufactured to ANSI a 10.11 for personnel nets.
* Extruded aluminum slide rails constructed of Aluminum Alloy 6061-T6 with an ultimate tensile strength of 18 KSI, a yield strength of 8 KSI, and a shear strength of 12 KSI.
* Stainless steel (316) corner hooks

Each net assembly shall come with a permanently attached label with the following information:

* Name of the manufacturer.
* Identification of the net material.
* Date of manufacture.
* Date of prototype test.
* Name of testing agency.
* Serial number.

All stainless steel hardware and instructions necessary for proper installation of the net system shall be provided by the net manufacturer. Installation shall be in accordance with the manufacturers instructions.

The complete assembly, including the net shall be warranted against defects in material and workmanship for a period of 5 years from the date of purchase.

Wiring Bracket

A stainless steel wiring bracket shall provided with cord grip holders for the pump cords and the control cords. All cords shall extend from bracket through conduit to control box. No splices shall be made in the wiring between the control building and the pump station. Continuous cords must be used from the pumps to the junction boxes on the side of the control building. The wiring bracket shall be fastened to access frame of the wet well.

Sump Pump

A sump pump shall be provided for dewatering the valve vault back to the wet well. The pump shall be Hydromatic Model SD33A1 with 1/3 hp, 1 phase, 60 hz, 115v motor, or approved equal, designed for automatic dewatering of the valve vault. The pump discharge shall be 1-1/2".

SUBMERSIBLE PUMPS

General

Contractor shall furnish all labor, materials, equipment and incidentals required to provide four (4) non-clog submersible centrifugal pumps as specified herein. Two of the pumps shall be Jockey Pumps for low flow conditions (JP-1 & 2). Two of the pumps shall be High Service Pumps (HSP-1 & 2).

Jockey Pump Operating Conditions (JP-1 & 2)

Each Jockey Pump shall be rated 5 HP, 460 volts, 3 phase, 60 hertz, 1745 RPM. The pump unit shall meet an operating condition of 500 GPM at 16.1 Feet TDH. The minimum shut-off head shall be 38 feet. The pump shall be capable of handling a 3" spherical solid. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall reserve a minimum service factor of 1.20. The performance curve submitted for approval shall state in addition to head and capacity performance, the pump efficiency, solid handling capacity, and reflect motor service factor. The Jockey Pumps shall be Flygt NP3102.090, or approved equal, with an impeller diameter of 152 mm.

High Service Pump Operating Conditions (HSP-1 & 2)

Each pump shall be rated 25 HP, 460 volts, 3 phase, 60 hertz, 1160 RPM. Each pump unit shall meet an operating condition of 3590 GPM at 12.90' TDH with an additional point of 1500 GPM at 30' TDH. The minimum shut-off head shall be 43 feet. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall reserve a minimum service factor of 1.20. The performance curve submitted for approval shall state in addition to head and capacity performance, the pump efficiency, solid handling capacity, and reflect motor service factor. The High Service pumps shall be Flygt NP3171.090, or approved equal, with an impeller diameter of 274 mm.

Construction

The pump shall be a centrifugal, non-clog, solids handling, submersible type as manufactured by Flygt, or approved equal. The pump volute, motor and seal housing shall be high quality gray cast iron, ASTM A-48, Class 35B. The pump discharge shall be fitted with a standard ASA 125lb. flange, faced and drilled. All external mating parts shall be machined and Buna N Rubber O-ring sealed on a beveled edge. Gaskets shall not be acceptable. All fasteners exposed to the pumped liquids shall be 300 series stainless steel.

Motor

The pump motor shall be of NEMA B, induction type with a squirrel cage rotor, shell type, watertight, explosion proof rated for Class1, Division 1, Group C & D design. The stator windings shall be insulated

with moisture resistant Class H insulation rated for 180 C. The stator shall be insulated by the trickle impregnation method using Class H polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The motor shall be designed for continuous duty. The motor shall be capable of withstanding at least 15 evenly spaced starts per hour. The rotor bass and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded ion the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel. The motor service factor shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out.

Bearings

The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single ball type bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum bearing life shall be 50,000 hours.

Mechanical Seals

Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber, shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide seal ring. All rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system.. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal system shall not rely upon the pumped media for lubrication. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

Shaft

The pump motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be AISI type 431 stainless steel. Shaft sleeves will not be acceptable.

Impeller
The impeller shall be of gray cast iron, ASTM A-48 Class 35B, dynamically, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The leading edges of the impeller shall be hardened to Rc 45 and shall be capable of handling solids and fibrous materials.

Volute
The pump volute shall be a single piece gray cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

ELECTRICAL/CONTROL EQUIPMENT

Scope
This section of the specifications covers acceptable materials and methods for installation of the storm water pump control system, which shall be completely prefabricated in a housed structure and include the following components:

Motor Control Center Equipment
Instrumentation (Submersible Pressure Transducer and Float Switches)

A 3 phase, 277/480 volt, 4-wire electrical service shall be coordinated and installed in conjunction with the local electrical utility.

The manufacturer shall assume "*Unit Responsibility*" for the complete control package. The manufacturer shall be responsible to provide all controls and appurtenances required for a fully functional system. In order to ensure compatibility and overall system function it is the intent of this specification that all components specified herein be supplied by a single vendor as manufactured and furnished by Metropolitan Equipment Company, or approved equal.

Electrical Service
The electrical service feeding the pump station shall be 3 phase, 277/480 volts, 60 Hz, 4-wire. The installing contractor shall be responsible for the meter socket suitable for mounting on the exterior of the control building. The equipment shall be installed in conjunction with all local and state codes.

Motor Control Center Equipment
The control center shall contain the equipment specified herein including all auxiliary equipment required. Control center equipment such as circuit breakers, magnetic starters, pushbuttons, pilot lights, etc., shall conform to the specifications as listed in this section. The motor control center shall be delivered to the control building in sections, which shall then be bolted together to form a complete unit.

Control circuits shall be 120 volt, single phase supplied from and individual control circuit transformer with fused primary and secondary for each starter unless otherwise designated on the plans. The transformer shall be sized to provide the power required to operate any piece of equipment in the control circuit.

MCC lighting transformer shall be of the dry type with the following ratings: single phase, 15 kVA, primary voltage 480 volts, secondary voltage 120/240 volts. The transformers shall be bottom located and provided with adequate ventilation. The transformer shall be constructed and tested in accordance with the latest revisions of IEEE, ASA, NEMA, and CSA standards for specialty transformers. All lighting

transformers shall be provided with some means of primary disconnect, and 2 kVA transformers and smaller transformers shall have auxiliary secondary protection set for no greater than the maximum continuous secondary current rating.

Lighting circuit breaker panelboards shall be sized and rated as shown on the plans, and shall have a minimum of 30 circuit breakers.

Circuit breakers

Circuit breakers shall be of the manually operated molded case type with frame size and trip rating shown on the plans. The circuit breakers shall be trip free from the handle and shall be complete with inverse time thermal and instantaneous overload protection. Circuit breakers shall comply with NEMA standards and shall be UL. Listed. All circuit breakers shall have fully interlocked covers.

Magnetic Starters

Magnetic starters shall have interchangeable three adjustable ambient compensated overload relays having inverse time operating characteristics and shall be field sized from actual motor nameplate values. Coils shall be of the 100 volt molded type. Magnetic starters shall conform to NEMA standard ratings. Each starter shall be furnished with a primary and secondary fused dual voltage 480-240/120 volt control circuit transformer except where specified otherwise. Control circuit transformers shall be oversized when the starter is utilized with solenoid valves, timers, alarm horns, and other auxiliary items shown on the plans.

An extra set of N.O. and N.C. auxiliary contacts shall be included with each starter. All magnetic starters shall be minimum size 1 unless otherwise specified.

Mounting and wiring of magnetic starters shall conform to NEMA standards.

Pushbutton stations, selector switches, pilot lights, control devices

Pushbutton stations, selector switches, pilot lights, and like devices shall be oil tight, heavy duty stations consisting of controls as shown on the plans. Pushbuttons shall be red for "stop" and black for "start" and as indicated on the plans or as selected by the engineer for other functions. All units shall be complete with non-tarnish legend function plates with functions as stated on the plans or approved by the engineer. Contact blocks shall contain not less than one pole, double throw contacts. Operators shall consist of the devices required to perform the desired function such as spring return, momentary contact, maintained contact, etc., as shown on the plans or described in these specifications. "Hold" position shall be a sliding latch engaging the "stop" button in the "off" position.

All pilot lights at control centers, individual starters, and pushbutton stations shall be of the 120/6-volt push-to-test transformer type units with colored plastic caps. Colors of the plastic caps shall be as designated on the plans or called for in the specifications.

Control Center Construction

Control center construction shall conform to the latest applicable standards of NEMA, AIEE, and ASA. Control centers shall be furnished assembled and wired in accordance with NEMA Class II Type B standards.

Control centers shall be arranged for "front-of-board" mounting with the rear enclosed. Vertical sections shall be bolted together to form the principal structures of freestanding control centers. All sections shall be 21 inches deep unless otherwise designated on the plans. The sections shall be supplied with bottom

channel sills, and shall be constructed of not less than 12 gauge sheet steel. Sections shall be given a prime coat of zinc chromate and shall be finished in a baked enamel.

Horizontal and main bus shall be copper, sized as shown on the plans, and shall be mounted in the top section of control centers and extend the entire length except when cut and supplied with splice bars when necessary for shipment and erection. Joints shall be silver-plated. Tin plated aluminum bus will be acceptable subject to prior approval by the engineer.

Vertical bus shall be rated at a minimum of 300 amperes or greater if the total connection load is greater with feeder breakers considered at full rating. Vertical bus and joints are to be silver-plated. All bus shall be securely supported and braced to withstand a direct bolted short up to 65,000-rps amperes, unless otherwise indicated on the plans.

All combination starters or contactors larger than size 3 and circuit breakers with frames 1a and larger need not be of the "draw-out" type. All other combination starters and circuit breakers shall be of the "draw-out" type with plug-in silver-plated stab fingers which shall automatically engage and contact the vertical bus.

Wireways shall be of ample size for the service intended. Horizontal wireway shall form a continuous accessible trough along the front size of each section with separate hinged access doors.

Doors shall provide complete access and shall be constructed of not less than 12 gauge steel and shall be complete with keepers, gaskets, and piano type hinges.

Each unit shall be identified by engraved plastic laminate nameplates, black letters on a white background.

Motor Control Center shall contain the following:

A. 200 amp, 480 Volt, 3 Phase, service entrance main circuit breaker

B. Circuit breaker, magnetic starter, overloads, control transformer and run light for one 5 HP jockey pump 1

C. Circuit breaker, magnetic starter, overloads, control transformer and run light for one 5 HP jockey pump 2

D. Circuit breaker, magnetic starter, overloads, control transformer and run light for one 25 HP high service pump 1

E. Circuit breaker, magnetic starter, overloads, control transformer and run light for one 25 HP high service pump 2

F. Logic control section with OIT

G. Lighting panel section

H. Transient voltage surge suppressor.

I. Electric unit heater supply and control.

Logic Control Section

The pumping system shall be supervised and controlled by a microprocessor based control computer. The control panel shall be a complete automatic control package consisting of the control computer, operator interface, and discreet operator controls. All customer connections shall be wired to individually numbered terminals and wires shall be numbered at both ends for ease of troubleshooting. The operator interface screen shall be mounted on the enclosure door. An H-O-A switch and run light shall be supplied for each pump. Terminal strip shall be provided for connecting pump and control wires. Elapsed Time Meters shall be furnished for each pump. Lights shall be supplied to for indication of low level, high level, pump operation, float back-up mode, and utility line power being used.

Programmable Logic Controller

The Central Processing Unit shall be microprocessor based with a real-time multi-tasking executive operating system stored in EPROM. The CPU shall provide a minimum of 128k of CMOS RAM for user programs and data. The memory shall be protected by an on-board lithium battery. The processor shall be a single chip 16 bit CMOS microcomputer operating at 14.74 MHZ. The CPU shall be equipped with a hardware clock/calendar and watchdog timer.

CPU shall function as specified over an ambient temperature range of -40 degrees to +60 degrees C with a relative humidity up to 95%. Central Processing Unit shall be certified and proven to conform to radio frequency emissions standards DOC/CSA C108.8 and FCC Part 15 Subpart J.

The following diagnostic indicators shall be provided:

- Power supply output status of all outputs
- Program execution status
- Processor reset status
- Error status by flashing a binary error code

The controller shall utilize a switch mode power supply exhibiting at least 70% efficiency to minimize heat build up. The inputs to the power supply shall be 24vac, 60hz ± 20%, or 12vdc to 40vdc. The ac and dc inputs will be separate and independently fused.

Control functions shall include real-time, multi-tasking PID program blocks for feedback control algorithms. Up to 16 PID loops shall be capable of executing at the same time.

Each control loop shall have an independent execution period. The PID block shall support set point tracking, cascade set points, anti-integral windup, derivative gain limiting, output limiting, square root extraction and input/output biasing.

The controller shall provide two RS232 and one RS485 communications ports. All communications shall be interrupt driven to allow communication concurrent with other activities.

The controller shall include one modem port to allow two-way data communications. The modem port shall be configurable for a bell 202 modem. Communications with the central computer site will be via standard dedicated telephone lines and shall be compatible with existing.

The bell 202 modem shall support 2 wire and 4 wire mode. The modem shall employ an anti-streaming timer to detect and prevent the transmitter from remaining stuck in the transmit condition.

Modems shall be FCC and DOC approved for connection to the public access telephone network. Reed relays are not acceptable for off-hook or radio transmitter key control.

The controller shall be equipped with the required number of analog inputs complete with surge suppression and filtering. Optional measurement ranges shall include 0-1v, 0-5v, 0-20ma, and 0-10v.

Analog inputs shall be differential (floating) with respect to ground, and shall operate accurately with up to 35 volts of common-mode voltage. The inputs shall provide a minimum of 400 kilohms impedance relative to ground and 800 kilohms differentially.

The analog to digital converter shall provide a minimum of 14 bits bipolar (14 bit plus sign). Analog inputs shall provide an absolute accuracy of 0.1 percent over the specified temperature range. Analog inputs shall be configurable for filter constants to automatically dampen signal noise.

In addition to external analog inputs, the controller shall have internal analog input channels to measure the temperature of the controller and lithium backup battery voltage. These signals may be used by the program to annunciate excessive temperatures or impending need for battery replacement.

The controller shall be equipped with the required number of analog outputs. The controller shall include an onboard power source to drive the outputs. Each analog output shall be capable of driving 20ma. If the output is a 4-20ma output, it shall be capable of driving the 20ma into a 1000 ohm load. The output shall maintain the last output value until it is updated. The resolution of the output shall be 12 bits.

The controller shall be configured with the appropriate number of digital inputs/outputs. All inputs shall be optically isolated with surge suppression. Each input shall be completely independent without a common ground. Outputs shall be individually isolated without a common ground. Solid state triac or transistor outputs are acceptable. The controller shall also be capable of providing dry contact, form C relay outputs.

All inputs and outputs shall survive ANSI/IEEE C37.90 surge withstand capability tests without damage.

Controller firmware shall provide real-time multitasking allowing up to fifteen independent tasks. Operating Program language shall be ladder, with specialized function modules written in "C", permitting specific program functions such as flow computations, data logging and the creation of custom communications protocols. The program shall be factory installed and tested in the system and shall have provision for field reprogramming. A disk and printed copy of the operating program shall be maintained on file with the manufacturer, and a copy of the final program on a disk shall be furnished to the customer for file.

Operator Interface

The operator interface panel shall show system status, and shall provide the operator with convenient screen keys for the entry of pass codes, set points, and commands. Multi-level password protection shall be available to prevent unauthorized set point changes. All information displayed on the screen shall be in plain English or simple graphic representations.

The operator interface shall consist of a 6" monochrome touch panel

The display panel shall include power conversion circuitry and a graphics drawing controller with four text sizes, graphic symbols library, graphics editor, and screen memory. The touch panel shall be integrally attached to the display screen bezel, and shall be spaced at a distance of 1/16" from the display panel. The touch panel shall be sealed from dirt & moisture, shall not exhibit parallax within the viewing angle, and shall permit a minimum of 160 programmable touch points per screen.

Statistical Display Screen:

- Pump Status (Off/running/alarm) - each pump
- Pump Running Hours - each pump
- Wet well Level
- Level Set Points
- Alarm Conditions
- Transmitter Failure
- Back-up Float Mode

Set Point Screens:

- Level Set Points
- Alarm Set Points

The assembly shall not require more than 5 inches of enclosure depth, and shall allow full use of the enclosure interior back panel for the host microprocessor and discrete control components.

System Operation

The control system shall operate pump(s) as necessary to satisfy the wet well level as set by the operator. The microprocessor based computer shall coordinate operational input signals including the system set points, wet well level signal, selector switch positions, indicator lights, and alarms. The computer shall coordinate pump operation, alternation, and system alarms.

The lead Jockey Pump shall operate as required at constant speed to maintain low flow station operation. If the incoming station flows are such that the Jockey Pump cannot keep up with the incoming flow, the Jockey Pump shall be disabled from the system operation and the lag pumps shall take over. The lag pumps are the High Service Pumps, which shall also be constant speed. Pump staging shall be computer controlled. Operation of both of the lag pumps shall stop when the flow is within the capacity of the lead high service pump. Lead and lag pump staging set points shall be operator adjustable.

The control computer shall be responsive to the wet well level. Level shall be compared to the adjustable set point and conditioned for stable operation. Alarm and override staging set points shall be programmed as a deviation above and below the set points.

The pumping system shall be programmed with an operational program. Minimum and maximum set points shall be programmed into the control system that shall limit the operator selectable control range of the computer to safe limits, within the system design range. The operator shall be able to change the system set points through the operator interface, within the preprogrammed safe limits.

Floats shall be provided as a back up to primary transducer level controls. The "off level" will be set at elevation 598.50. As inflow enters the wet well, the sump level will rise above the "off level" of 598.50 and energize the system. As the water level rises in the wet well and the water level reaches the "Jockey Pump start" elevation of 602.00, the lead pump will start. The low flow Jockey Pump will always be called upon to start as the lead pump. If the water level in the wet well drops to elevation 598.50, the "off level" will be sensed and the lead pump will turn off. The Jockey Pumps will alternate so that the lead Jockey Pump will be different upon each successive pump cycle operation. If the water level continues to rise when this low flow Jockey Pump is operating and the elevation of 606.50 is sensed, the low flow Jockey Pump will shut-off and the lead High Service Pump will start. If the water level of 606.50 is reached, the flow into the station is greater than the rating of the low flow Jockey Pump. If the water level

in the wet well drops to the elevation 598.50, the "off level" will be sensed and the High Service Pump will turn off. If the water level continues to rise when this lead High Service Pump is operating and the elevation of 610.50 is sensed, the lag High Service Pump will start and both of the High Service Pumps will operate in parallel. With both High Service Pumps operating, if the water level continues to rise and a wet well water elevation of 611.00 is sensed, the high level alarm will be triggered. If, while both pumps are operating, the water level falls in the wet well to an elevation of 609.50, the lag High Service Pump shall turn off and the lead High Service Pump shall operate until a wet well elevation of 598.50 is sensed. When this 598.50 elevation is sensed, this means the "off level" has been reached and satisfied the system's need. If the water level continues to fall and an elevation of 597.50 is sensed, a low level alarm shall be triggered.

Upon completion of each pumping cycle involving at least one High Service Pump, the lead High Service Pump shall alternate. The same is true for the Jockey Pump operation.

If one pump should fail for any reason, the next available pump shall operate on the override control. All level switches shall be adjustable for level setting from the surface.

The system shall operate completely unattended, and shall have running, lock-out, and failure contacts for optional connection to supervisory controls. An alarm light on the exterior of the pump station shall be provided. Battery backup and dim glow circuits for the exterior alarm light shall be provided. The alarm light shall flash bright on the following alarm conditions:

High Wet well Level
Low Wet well Level
Building Intrusion
Power Fail

Cross-Connection Drain Pipe Controls and Construction

In order to prevent freezing in the section of the force main with less than 5 ft. of cover, a drain pipe will be installed at station 64 + 00. This drain pipe will drain all force main piping downstream of station 64 + 00 after the station has finished a pumping cycle. The drain pipe will drain the storm water into the proposed 15-inch RCP storm sewer to be located directly north of the force main.

The drain pipe and associated appurtenances shall be constructed as shown on the plans. The drain pipe will be constructed of 2-inch SCH 80 PVC pipe, which will be connected to the force main with a 24-inch double strap service saddle with a 2-inch tap manufactured by A.Y. McDonald, or approved equal, and connected to the storm sewer to make a watertight connection with Link-Seal, or approved equal. The circumference of the asphaltic-coated force main shall be poly wrapped with Visquine, or approved equal, extending 1 foot on either side of the service saddle before installing the saddle to prevent galvanic action.

Flow through the drain pipe will be regulated by an electrically operated 2" stainless steel ball valve manufactured by Dynaquip, Model #191018, or approved equal. When any of the pumps in the storm water pump station are pumping, the ball valve will be signaled to fully close, preventing flow from entering the connected storm sewer. When the pumps in the storm water pump station shut off, the ball valve will be signaled to fully open, allowing drainage into the connected storm sewer. The ball valve is to be located in a 4-ft. diameter Type A valve vault (with no conical top section) with a 2-ft. diameter Type 1 access cover.

Wiring to the electronically operated ball valve will be comprised of 4 No.10 wires for valve motor operation, 4 No. 10 wires for valve position indication, 2 No. 10 spares, and 1 No.10 ground. These wires will be housed in a 1 ¼" Sch. 80 PVC or HDPE conduit attached to the force main. The wiring will: 1) open and close the ball valve, and 2) provide indication back to the controls building on the "open" or "closed" state of the valve from the limit switches on the valve.

Alarm Dialer

A telephone dialer shall be furnished as an integral component of the pump control system. The dialer shall include 8 separate alarm inputs and shall be expandable to 64 inputs. The capacity for telephone numbers to call shall be 16. Two call directories shall be included, with the ability to call from the numbers in each directory of 8. Alarms shall be programmable as to which directory calls shall be made from. Acknowledgment digits and number of rings shall be programmable. The alarm codes shall be the same as Cook County Highway Department's existing pump stations, which shall be coordinated with Meade Electric Company, Inc.

Alarm dialer shall alarm the following points:

Building Intrusion
Pump Fail
High Wet Well Level
Low Wet Well Level
Utility 1 or 2 Power Outage
Fire / Smoke Detection
Pump Seal Fail / Thermal Overload
Float Back-up Mode

INSTRUMENTATION

General

Instrumentation shall consist of primary sensing elements and transmitters for level and flow sensing. Level sensing equipment shall not be installed in direct line of turbulence from wet well inlet or pump suction lines.

Submersible Level Transducer (Primary Operation)

Wet well level shall be sensed with a submersible level transducer. The transducer housing shall be 316 stainless steel fitted with a SS cable support bracket. The transducer shall be located in a PVC stilling well furnished by the contractor, as detailed on the plans.

Liquid level shall be sensed by the deflection of a stainless steel diaphragm having a displacement of less than 5 cu.mm from 0 to full scale. The atmospheric pressure side of the diaphragm shall be bonded to a silicon strain sensor coupled to an integral bridge circuit. Atmospheric venting shall be through the signal cable, directly to atmosphere. Transmitters requiring separate, sealed, expansion breathing systems shall not be accepted.

Electrical connection shall be 2 wire, 4-20 madc, and shall be reverse polarity and surge protected.

Accuracy shall be 0.6 percent of full scale. Full scale range shall be 0 to 14 feet (or as shown on the plans). Temperature compensated range shall be -20 to 122 degrees f., maximum operating temperature shall be -40 to 176 degrees f.

Float Switches (Back-up Operation)
Float switch shall be steel tube mercury design sealed in a solid polypropylene float. Float shall be leak-proof and corrosion resistant.

Power cord shall be 2 conductor #16 flexible cord type SJOW-A water and oil resistant, 300 volt. Switch rating shall be 2 amps at 115 or 230 volt ac. Float switch operating temperatures to 160□F.

Provide a chain & anchor mounting system for the floats and transducer as shown on the drawings.

PREFABRICATED CONTROL BUILDING
The shelter shall be supplied as manufactured by Miller Building Systems of Elkhart, IN, or approved equal.

All electrical and electronic equipment shall be securely mounted in accordance with manufacturer's recommended installation procedures.

Shop drawings and calculations detailing the design of the building foundation, including suitable reinforcement, and containing the seal of an Illinois licensed structural engineer, shall be submitted prior to construction. Note that the net allowable bearing capacity of the soil, according to geotechnical information obtained, is 2,000 lbs/ft^2.

Shelter Size. The shelter shall be delivered with general layout and dimensions as shown on the plans.

Wall. The four exterior shelter walls shall be constructed of 6-inch solid concrete, reinforced with ASTM Grade 60 rebar. Welded wire fabric and or fiber reinforcing not permitted. Wall shall be constructed to withstand winds of no less than 150mph.

The concrete wall construction shall meet Underwriters Laboratories Standard for Safety for Bullet-Resisting Equipment (UL-752) Level IV (30.06 @ 15'). Interior wall finish to be ½" wood paneling covered with white embossed FRP.

Floor. The shelter shall have a solid concrete floor. The interior floor shall be entirely covered with 1/8-inch vinyl tile and finished with 4-inch, Black baseboard molding. The floor shall clear span and be supported by a perimeter wall foundation. It must be able to support uniformly 300 lbs/ft^2 and a concentrated load of 3,000 lbs. over a 2.5 ft^2 area. It must be possible to lift the shelter including no less than 5,000 lbs. of equipment. The shelter manufacturer shall also furnish all necessary anchor bolts and hardware. For any control cabinets to be mounted on the floor, 6" concrete mount pads shall be incorporated into the cast.

Roofing/Ceiling. The shelter shall have a solid concrete roof and shall be pointed with at least 2-inches of overhang on all sides. The interior ceiling shall be finished with ½" paneling covered with white embossed FRP. The shelter shall be designed to withstand a snow loading of 150 psf.

Insulation. The four walls and ceiling shall have an R-11 insulation rating.

Exterior Finish. The shelter's four exterior walls will be fluted finish (Green Streak form liner #312M). The door, roof, trim and HVAC units shall have a complimentary exterior finish that will protect the base metals.

Penetrations. The shelter manufacturer shall design and provide all shelter penetrations to ensure all required systems work as designed. In addition to penetrations associated with systems described in this

specification, the shelter shall have the following penetrations:

Cable Entry. One (8) eight-position, 4-inch cable entry port with seal caps in a horizontally oriented 4 by 4 configuration.

Access Door. The shelter shall have one 316L stainless steel door with frame. The shelter door shall have dimensions of 3-feet by 7-feet. The shelter door shall have a removable spring shock absorbing stay chain to prevent door from swinging past 90 degrees, an exterior pick-guard, and a sweep mounted on the bottom edge. The door catch shall be placed 6" from the exterior doorknob. The interior side of the door shall have a panic bar. The shelter doorframe shall have a threshold and weather stripping to prevent the interior controlled environment from escaping while the door is in the closed position. The shelter door and frame shall be primed and painted to protect the base metal and match the exterior finish.

Door Lock. The shelter door hinges shall be located on the outside of the structure and shall have three stainless steel non-removable pin hinges. The door shall have installed one mortise dead bolt with Best key removable core with 7 pin cylinder. The door handle and lock shall have a chrome finish.

Weatherproofing. The interior shelter environment shall be designed and constructed to prevent ingestion or leaks of inclement weather.

Interior Fluorescent. The shelter shall have (2) installed fluorescent overhead lighting. These lights shall be connected to a standard lighting switch mounted near the door. The fluorescent lighting fixtures shall be 4-feet long, dual-bulb with vaportight lens. Manufactured by Metalux VT2-232-52-dr-120-EB8 low temp ballast

Exterior Fluorescent. The shelter shall be furnished and installed with a 52-watt fluorescent lamp fixture with photocell manufactured by Lumark catalog # PLIPW52-120-PE.

Exterior Caged Alarm Light. The shelter shall be furnished and installed with a 100-watt incandescent caged alarm light manufactured by Stonco, model 2V566 or Lumark ICVWG . A low voltage dim glow light is also required. Furnish separate fixture if necessary.

Receptacles, Circuits & Switches. The shelter shall be furnished with the following:

120-volt receptacles. The shelter shall have installed (2) two 120-volt, 20-amp, dual receptacle outlets and (2) two exterior GFCI receptacle. The exterior GFCI receptacles shall be connected to a separate breaker from the interior receptacles.

Structural and Watertight. The shelter manufacturer shall provide a 10-year structural and watertight warranty.

Environmental Equipment

The building shall be supplied with heating and ventilating equipment as shown in the plans. Equipment shall be supplied to properly maintain an acceptable environment for all of the equipment that is contained with in the building.

The heater shall be a 5 kW, 17,065 BtuH Q-Mark Model MUH-05-41. This unit shall be supplied with the thermostat, diffuser, and mounting bracket for installation by the control building supplier. The unit shall be rated 480 VAC.

The exhaust fan and intake louver shall be supplied with a thermostat, shall be thermostatically controlled, and shall be manufactured by Dayton. The fan shall be shutter mounted, capable of 800 CFM, and shall be rated 115 VAC

Security System
The contractor shall furnish and install a security system tied into the autodialer system. The system shall have motion detectors and magnetic bars on all windows and exterior doors.

Fire Alarm System
The contractor shall furnish and install a fire alarm system tied into the autodialer system. The system shall include a ceiling mounted smoke detector with signal transmission to the autodialer system. The smoke detector shall be Kidde, Model PE120E, or approved equal, requiring a 110 volt supply and having a 110 volt output to the control panel/PLC.

SHOP DRAWINGS
Shop drawings shall be submitted in accordance with the "Submittals" section of these specifications.

Each set of shop drawings shall include, but not necessarily be limited to:

> Drawings showing dimensions of all equipment. Control details and electrical schematic diagrams. Performance data including, when applicable, pump curves, and motor data.
>
> All other information necessary to enable the engineer to determine whether the proposed equipment meets the requirements.

INSTALLATION AND OPERATING INSTRUCTIONS
Two (2) copies of a manual, containing installation instructions, operating instructions, wiring diagrams, parts list, and, where applicable, test data and curves shall be provided.

The contractor shall provide the services of factory-trained representative for a maximum period of one (1) day to start up the station and to instruct the owner's operating personnel in the operation and maintenance of the equipment provided.

WARRANTY
The manufacturer shall warrant his product to be free from defects in workmanship for a period of one (1) year from date of completion.

Warranties and guarantees by the suppliers of various components in lieu of a single source responsibility by the contractor shall not be accepted. The contractor shall be solely responsible for the warranty.

In the event a component failure to perform as specified or is proven defective in service during the warranty period, excluding items of supply normally expended during operation, the manufacturer shall provide a replacement part without cost to the owner.

This warranty shall be valid only if the product is installed, serviced, and operated under normal conditions, in accordance with the manufacturer instructions.

EQUIPMENT MANUFACTURER
In order to establish a standard of quality and to insure a uniform basis of bidding, pump station equipment shall be supplied by a single source.